# Space Weather Technical Forecast

Issued on Thursday, 13 April 2023 at 00:21 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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**Space Weather Forecast Headline: Chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout.**
**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity has been Low with continued C-class activity, mostly from AR3272 and AR3279, and from a new region which is appearing round the southeast limb. There are currently seven sunspot regions on the visible disc. AR3272 (Fai/Beta-Gamma) in the southern disc remains the largest region with continued fluctuations in its multiple intermediate spots. AR3279 (Eao/Beta-Gamma) near the southeast limb, is the next largest region on the disc. The smaller spot (AR3276) proceeding this had previously been classed as part of this group has now been separated. AR3273 in the northwest has decayed slightly through the period and is now classified Dao/Beta. All other regions on the disc are currently small or simple, although there is a new region appearing round the southeast limb that may contain further complexity.

There have been no Earth-directed CMEs observed in available imagery over the past 24 hours. A filament that lifted from the southwest around 12/0300 UTC has been analysed and it is expected to miss ahead and to the south of Earth's orbit, although there is a low chance of a glancing impact on the 16th April.

**Solar Wind / Geomagnetic Activity:** The solar wind as observed by DSCOVR at L1, has generally been slow, between 320 and 400 km/s. Density has been average or slightly below (1-7 ppccc). The total IMF, Bt, was weak (4-8 nT) through much of the period, but temporarily increased to moderate 12/1350-1440 UTC, with a peak of 10 ppcc. The north-south component, Bz, has been varying weakly between -4/+7 nT. The phi angle remained in a largely positive orientation (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

**Energetic Particles / Solar Radiation:** High energy proton flux (greater than 10MeV) as measured at GOES16, was at background levels. The high energy electron flux (greater than 2MeV) as measured at GOES16 was at background levels. The associated 24 hour fluence was below the Active threshold. The 13/0001 UTC observed fluence was 1.61e6 integrated pfu.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Solar activity is expected to be Low to Moderate, with a chance of isolated M-flares and a slight chance of an X-flare. AR3272 and AR3279 are the most likely sources of activity for now.

**Solar Wind / Geomagnetic Activity:** There are currently no expected Earth-directed CMEs, although there is a low possibility of glancing arrivals late day 1 into day 2 (13th/14th), day 3 (15th) and day 4 (16th). Solar winds are likely to remain at ambient levels through much of the period, but may become slightly elevated at times from late on day 2 (14th), due to weak interactions with positive coronal hole high speed streams. Geomagnetic activity is expected to generally be Quiet to Unsettled, with a chance of Active intervals, most likely in association with any transitory CME impacts.

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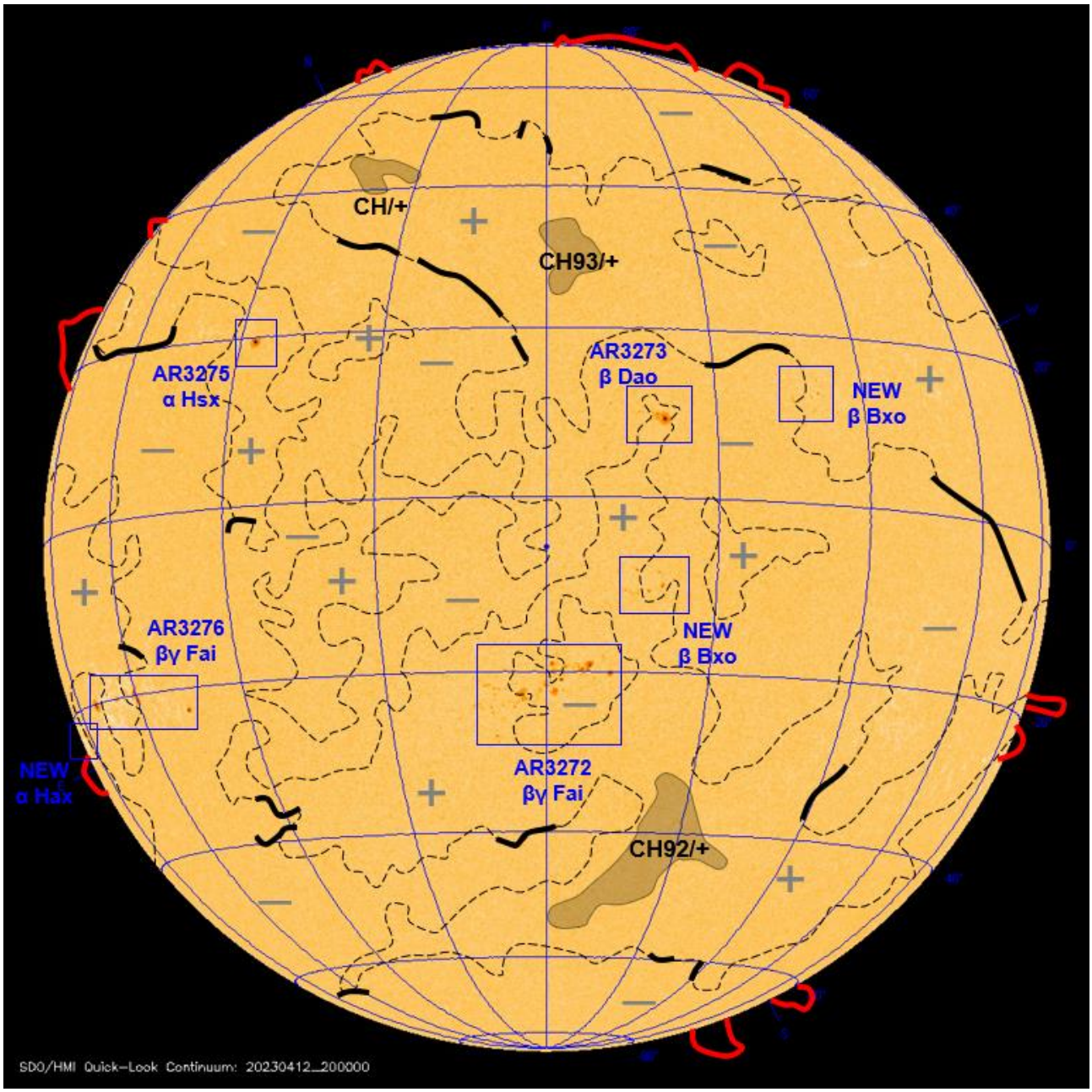
**Energetic Particles / Solar Radiation:** High energy (greater than 10MeV) proton flux is expected to persist at background levels, although there is a slight chance of greater than S1 event, with a large and complex sunspot region transiting the western hemisphere. High energy (greater than 2 MeV) electron flux is currently at background levels, but may see a modest rise over the coming days. The associated 24 hour fluence is expected to remain below the Active threshold (1e8 integrated pfu), perhaps on a rising trend.

**Figure 1. Solar Analysis Valid 12/2000 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

There are currently no expected Earth-directed CMEs, although there is a low possibility of a glancing impacts late day 1 into day 2 (13th/14th) and on day 4 (16th), due to filament eruptions from the southwest quadrant on the 9th and 12th respectively. There was also a dimming event observed on 171 imagery approximately 11/2000 UTC near centre disk. Limited signal has been observed on available choreograph imagery but the potential remains for this to be earth directed if a CME was produced, perhaps arriving at Earth on day 3 (15th) based on preliminary calculations, however confidence is low.
Otherwise, Earth appears to have exited the HSS associated with CH91/+, with winds close to ambient levels. Further positive coronal holes are present on the visible disk, CH92/+ in the south and CH93/+ in the north. These features give a potential for Earth to see slightly elevated solar winds from late on Day 2 (14th) onwards, however due to their relatively high latitude positions and positive polarity, any geomagnetic enhancement is expected to remain subdued with limited ENLIL signal for solar wind enhancement.
The forecast for geomagnetic activity is therefore for generally Quiet to Unsettled conditions throughout, with a chance of Active intervals, most likely in association with any transitory CME impacts.

| Geo-Magnetic Storm<br>Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 5 | 5 | 5 | 5 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

| Date/time 21.5R (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed | Estimated Arrival Time | Comments |
|---|---|---|---|---|---|---|
| 10/0220 | Partial Halo | Filament | SW limb | 540 km/s | 14/0000 UTC | Low chance of glancing blow |
| 12/0959 | Partial Halo | Filament | SW (40S, 45W) | 550 km/s | 16/0300 UTC | Low chance of glancing blow |

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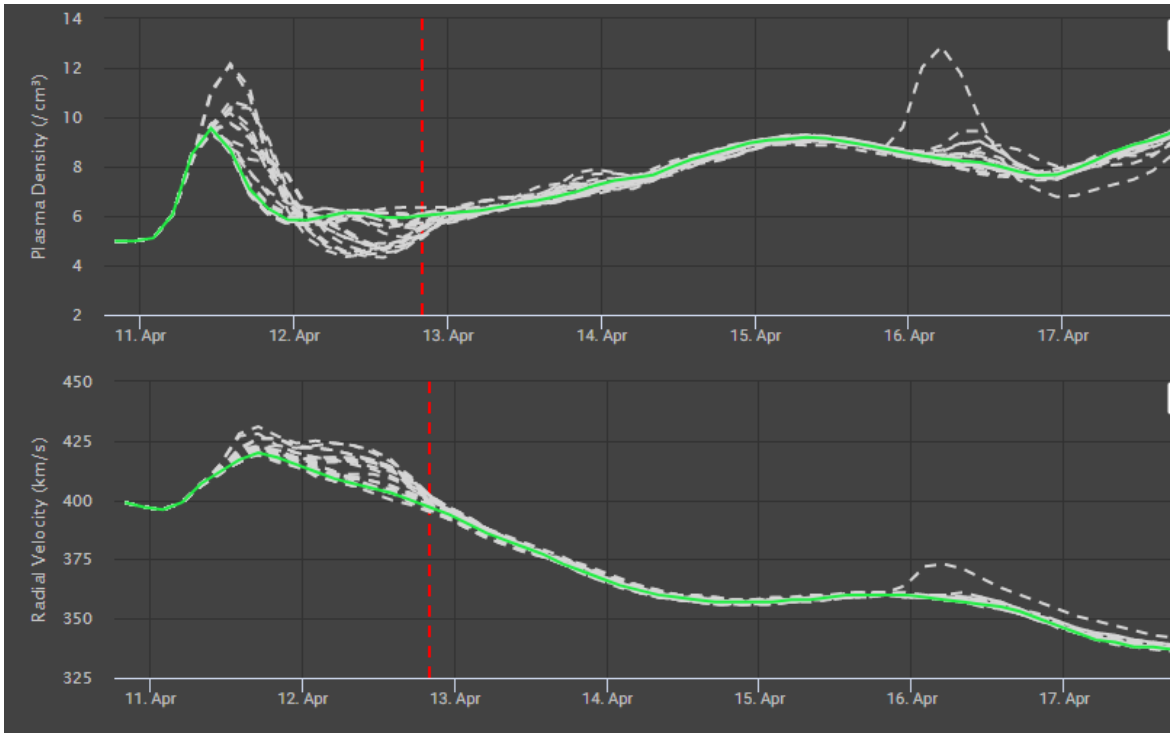
**Figure 2: Enlil Ensemble, with a few members showing CME arrivals**




## Radio Blackouts - X-Ray Flares:

Low to Moderate activity is expected with an ongoing chance of isolated M-flares and a slight chance of X-flares given the number of larger, more complex regions on the visible disc.
There are two sunspots which have a history of M-flaring, along with several low level C-flares. AR3272 is a large sized region in the central southern disc, and is comprised of multiple small spots, with some magnetic complexity due to a couple of small reverse polarity spots near the main negative leaders. AR3279, close to the southeast limb, also has a history of M-class flares. It is moderately large and it is also in a more magnetically complex Beta-Gamma formation. Another sunspot region is currently transiting round the southeast limb. Far sided products suggest that this region may have a degree of complexity that isn't visible yet and could potentially increase the flare risk, but this will need to be determined as it comes further into view. Another region of note is AR3273, which is a moderately sized beta group, although this region has shown signs of decay recently. All other regions on the disc are currently small or simple.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 50 | 50 | 50 | 50 |
| Very Active | R3 to R5 X Class | No | 10 | 10 | 10 | 10 |

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## Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES-16, is likely to remain at background levels through the period, however there is a slight chance of a greater than S1 event, with AR3272 transiting across the western hemisphere.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 10 | 10 | 10 | 10 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |

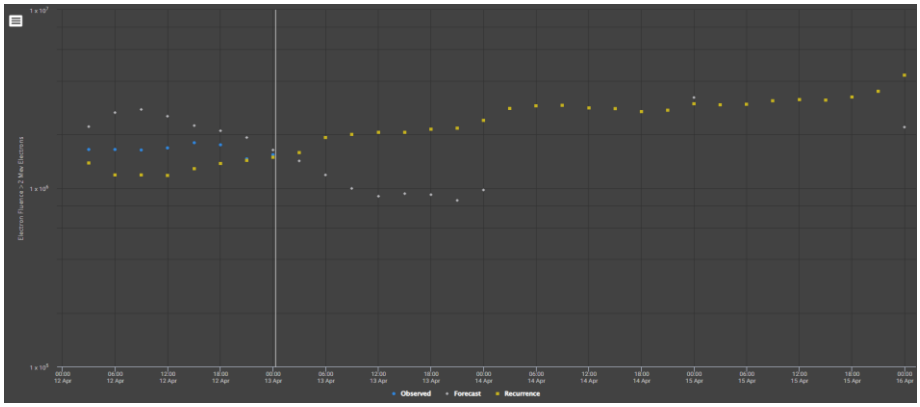
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

## High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux is currently at background levels, but is likely to rise in response to the recent solar wind enhancement. However, any rise is expected to be fairly modest and subject to uncertainty given the potential of glancing CME and HSS effects into the period.
The associated 24 hour fluence is currently expected to be below the Active (1e8 integrated pfu) threshold throughout, but perhaps with a slight rising trend. REFM is suggesting only minor rises and is presently considered to be giving good guidance.

| GEO Electron Environment Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | No | 5 | 10 | 20 | 20 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 1 | 1 | 1 | 1 |

**Figure 3: GOES-16 electron fluence and REFM data.**



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